Classification of District Heat Heat Exchange Stations Using Smart Meter Data

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Publication date:
2017

Document Version
Publisher's PDF, also known as Version of record

3rd international conference on
SMART ENERGY SYSTEMS AND 4TH GENERATION DISTRICT HEATING
Copenhagen, 12-13 September 2017
www.4dh.eu www.reinvestproject.eu www.heatroadmap.eu

Classification of District Heat Heat Exchange Stations Using Smart Meter Data

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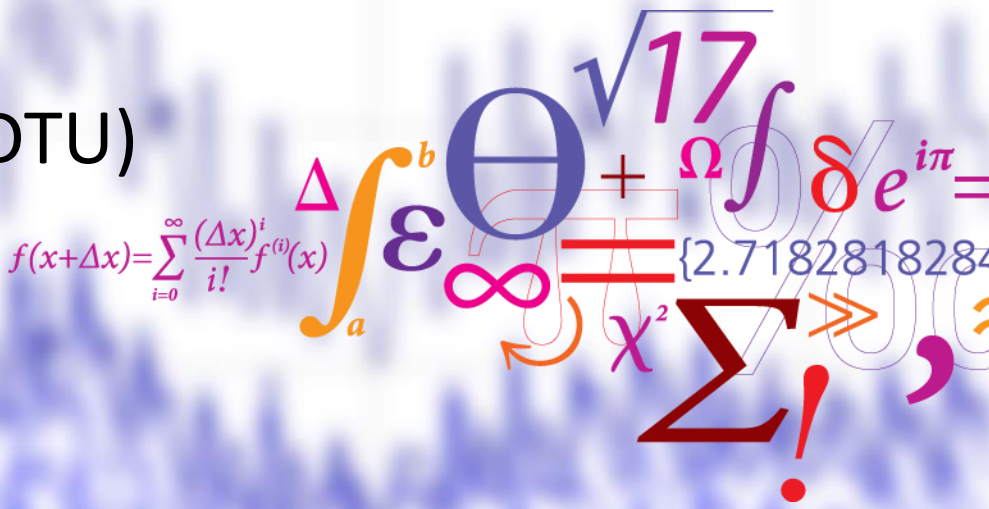
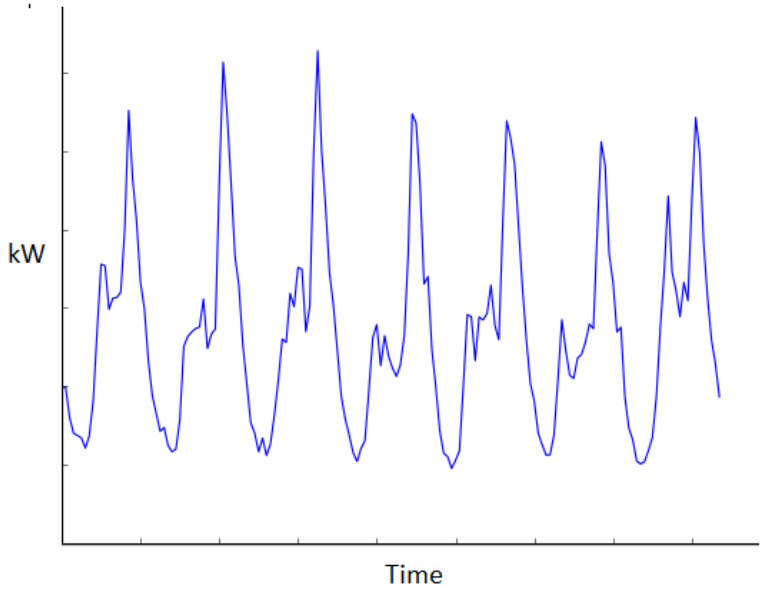
A. Bruun (AVA)



DTU Management Engineering
Department of Management Engineering

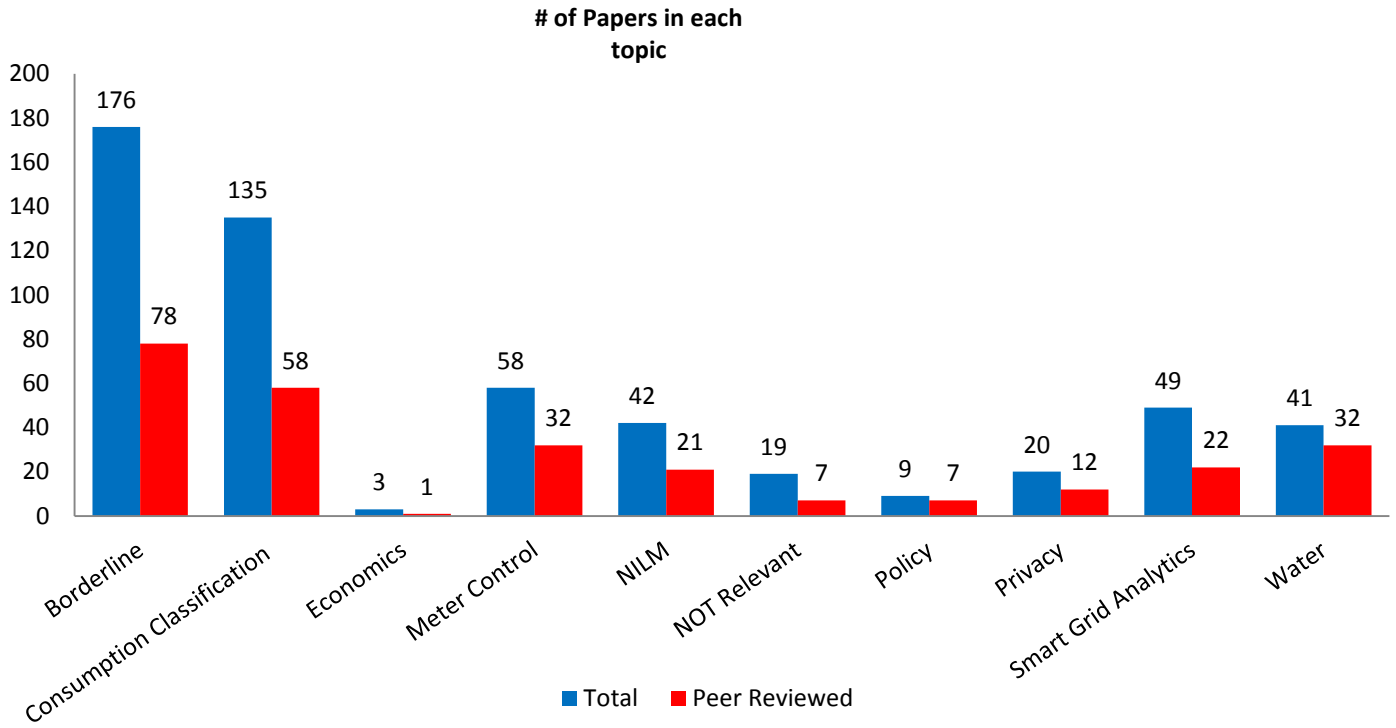
The Concept

Smart Meters



- Recording frequency down to seconds, usually 15 min – 60 min interval

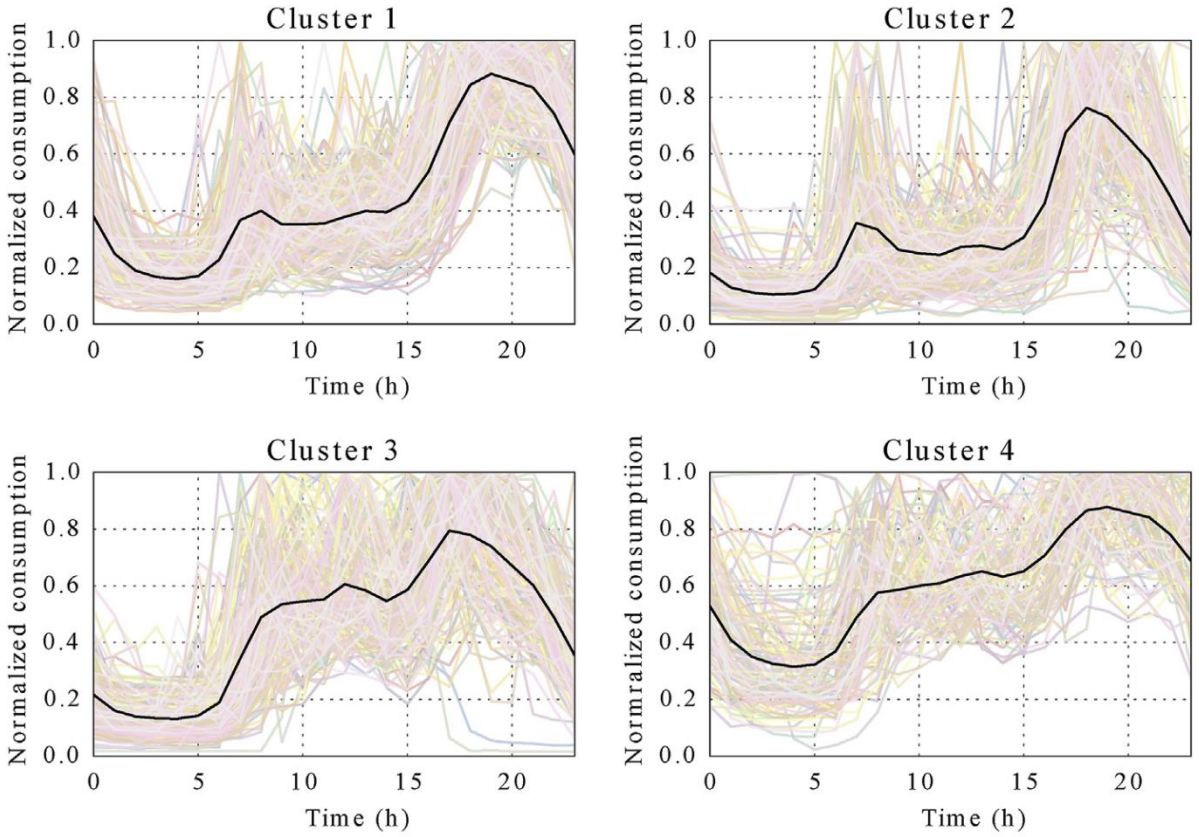
Smart Meter Data Application



Limited research on DH smart meters analytics!

Source: Tureczek. Alexander M, Nielsen. Per S. Structured Literature Review of Electricity Consumption Classification Using Smart Meter Data. Energies 2017;10:584. doi:10.3390/en10050584.

Electricity Smart Meters Clustering



Source: Viegas JL, Vieira SM, Melício R, Mendes VMF, Sousa JMC. Classification of new electricity customers based on surveys and smart metering data Commission for Energy Regulation. Energy 2016;107:804–17. doi:10.1016/j.energy.2016.04.065.

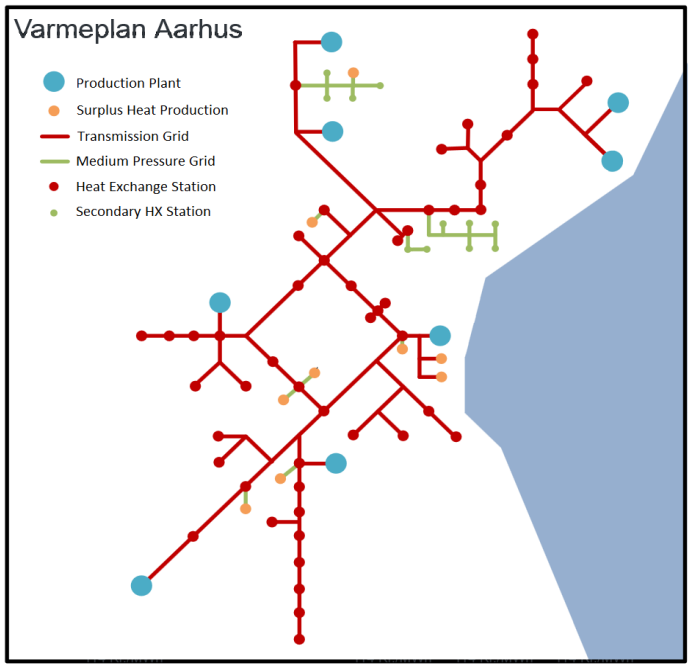
The Data

District Heat Data From AVA

District Heat data from Aarhus

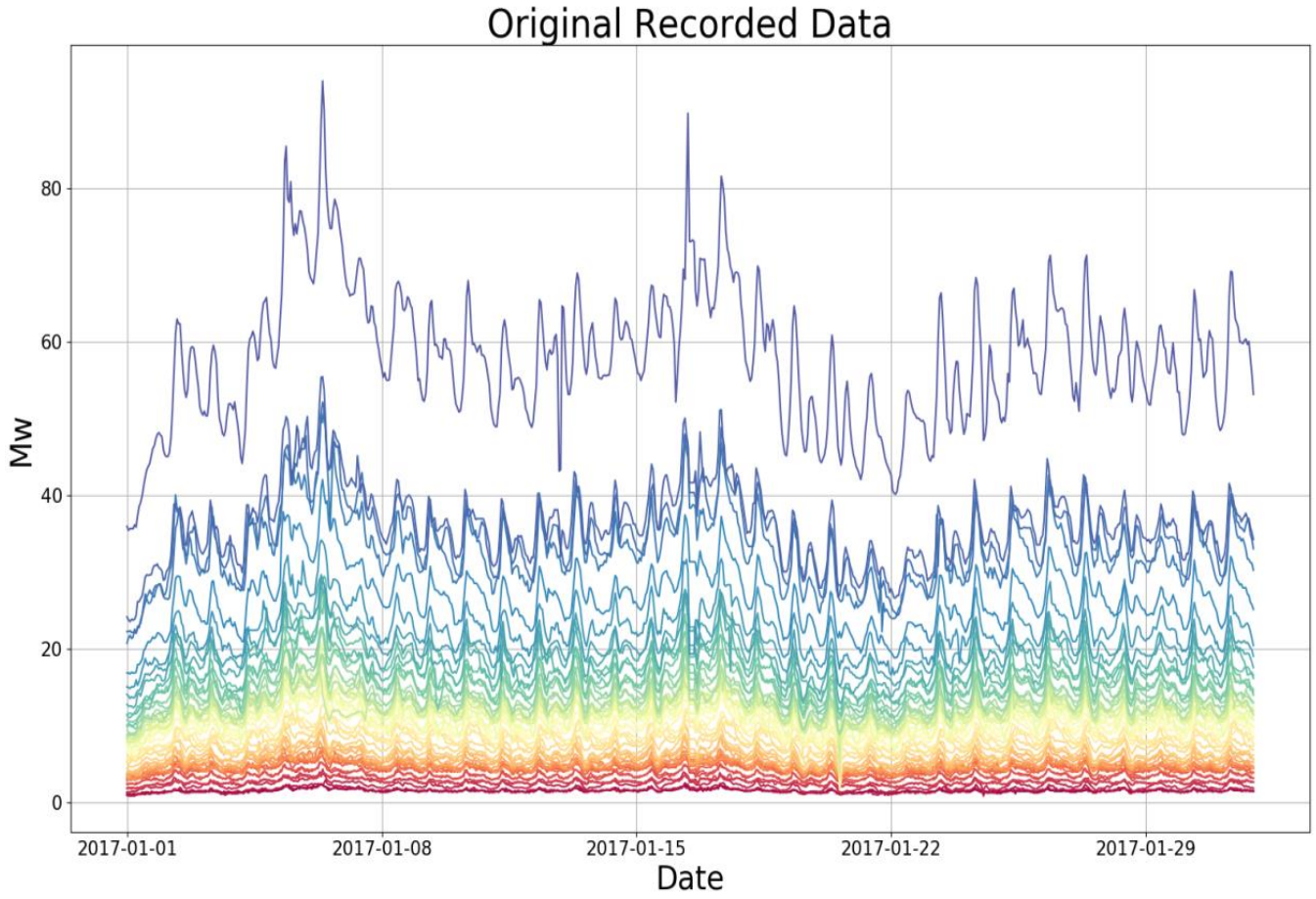
49 Heat Exchange stations (HX)

January 2017 (744) hourly observations per HX



Source: AffaldVarme Aarhus Varmeplan

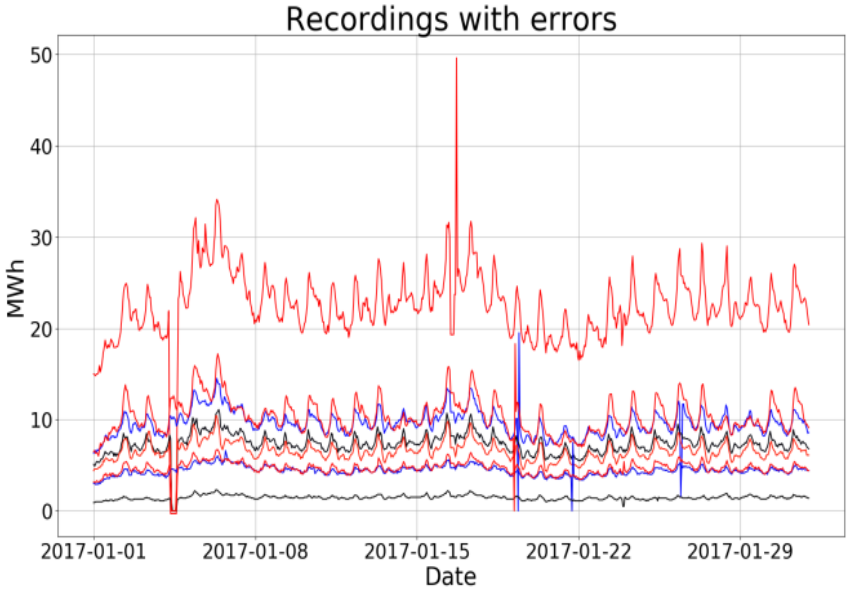
Ploting of the HX Smart Meter Data

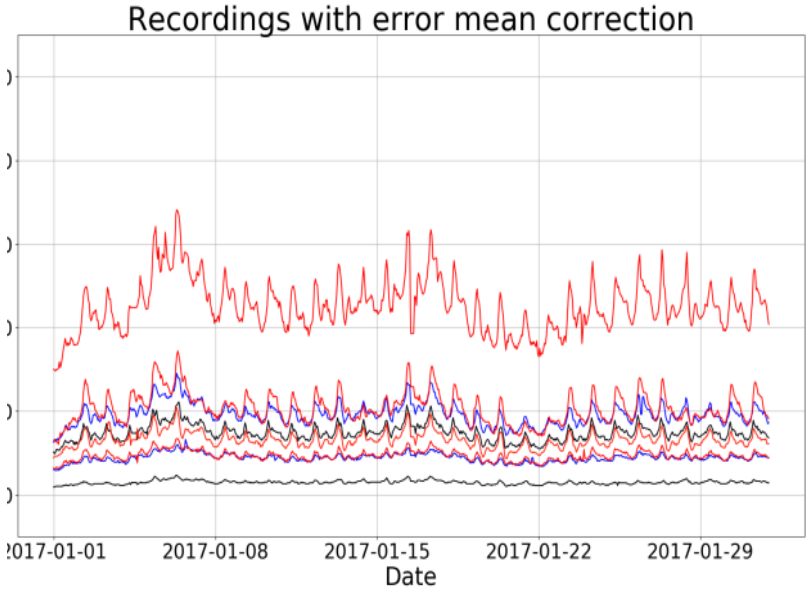


Large differences in consumption volume

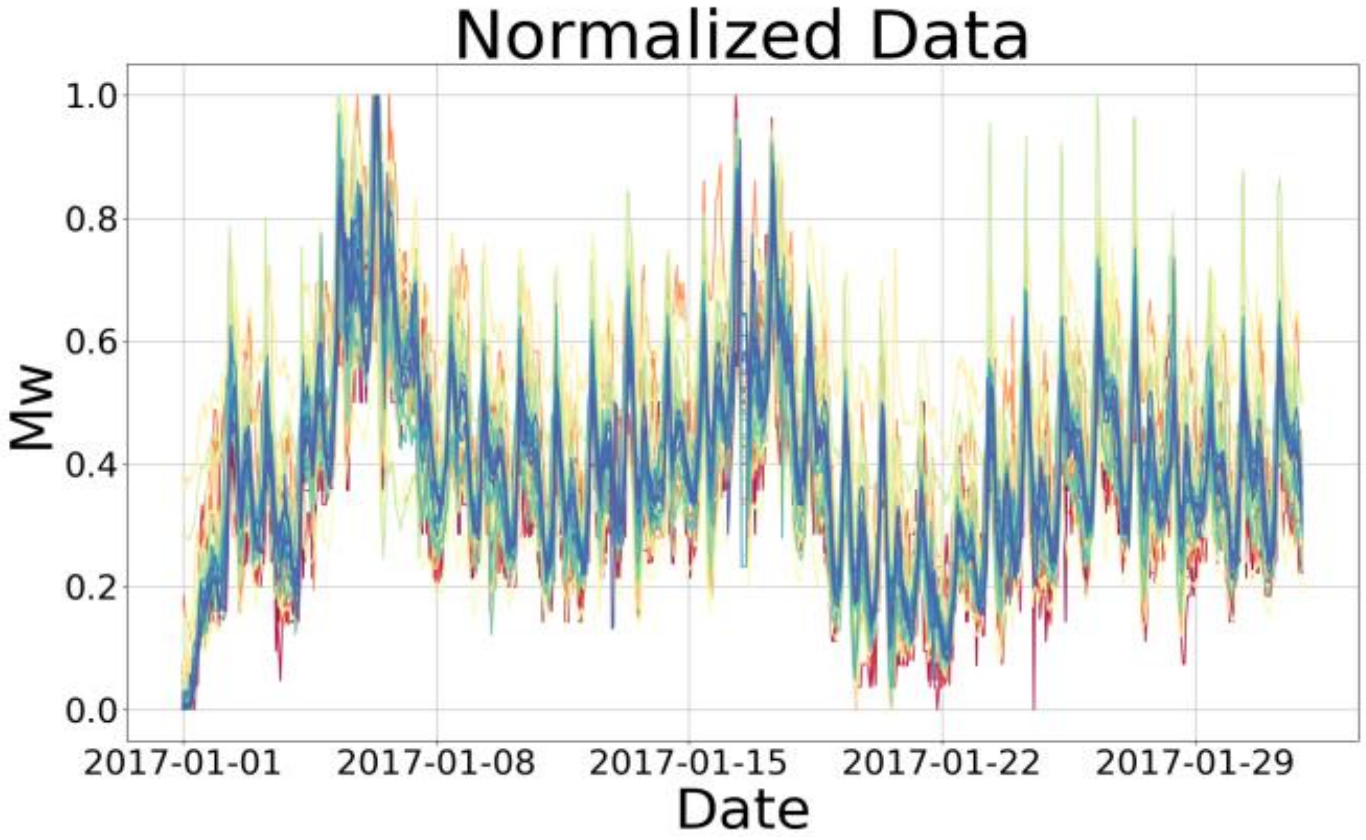
The Preprocessing and Cleaning of Data

Data Preprocessing of the AVA Data – Dealing with Missing Data



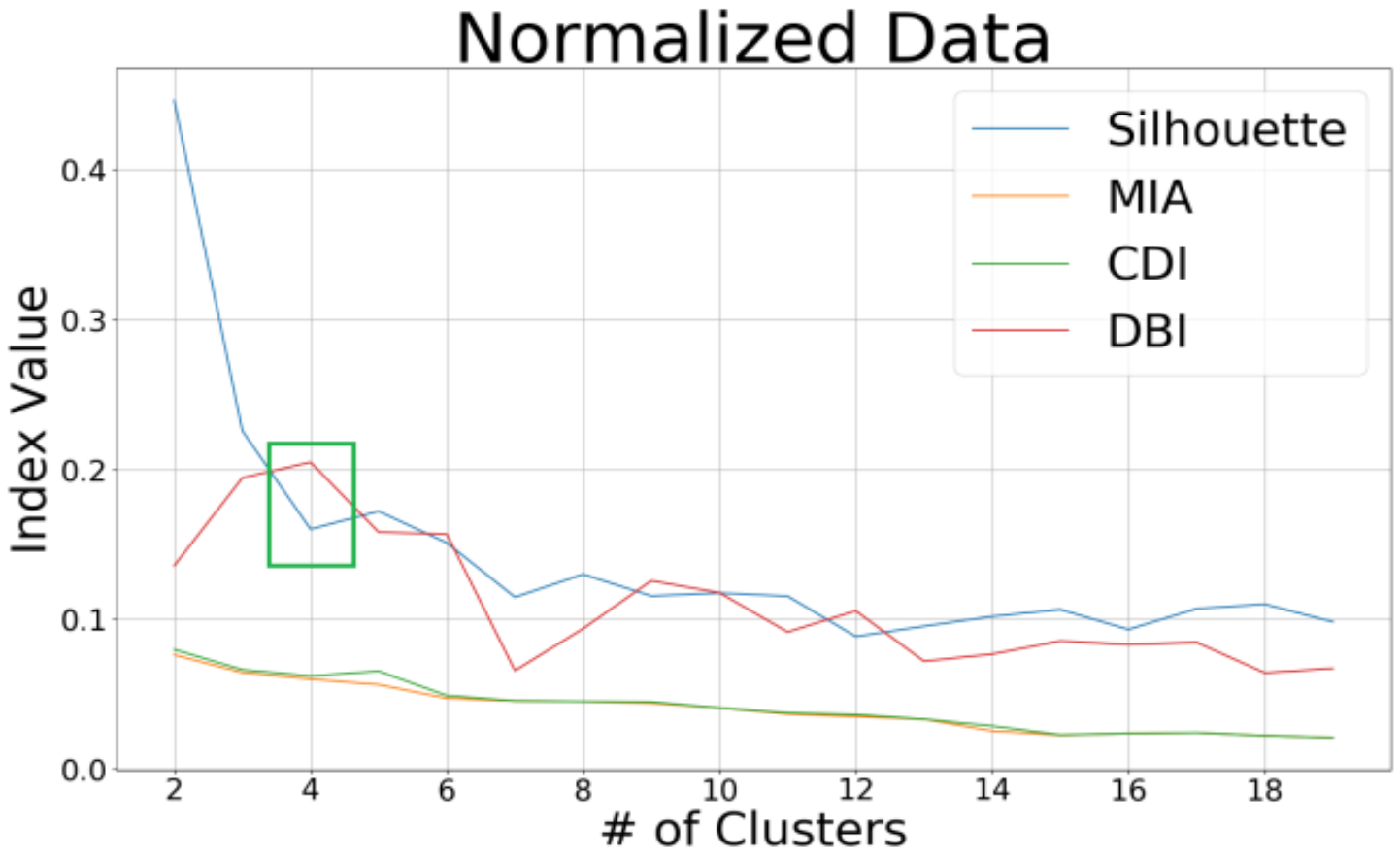


Normalizing Data to Remove Volume Influence on Clustering



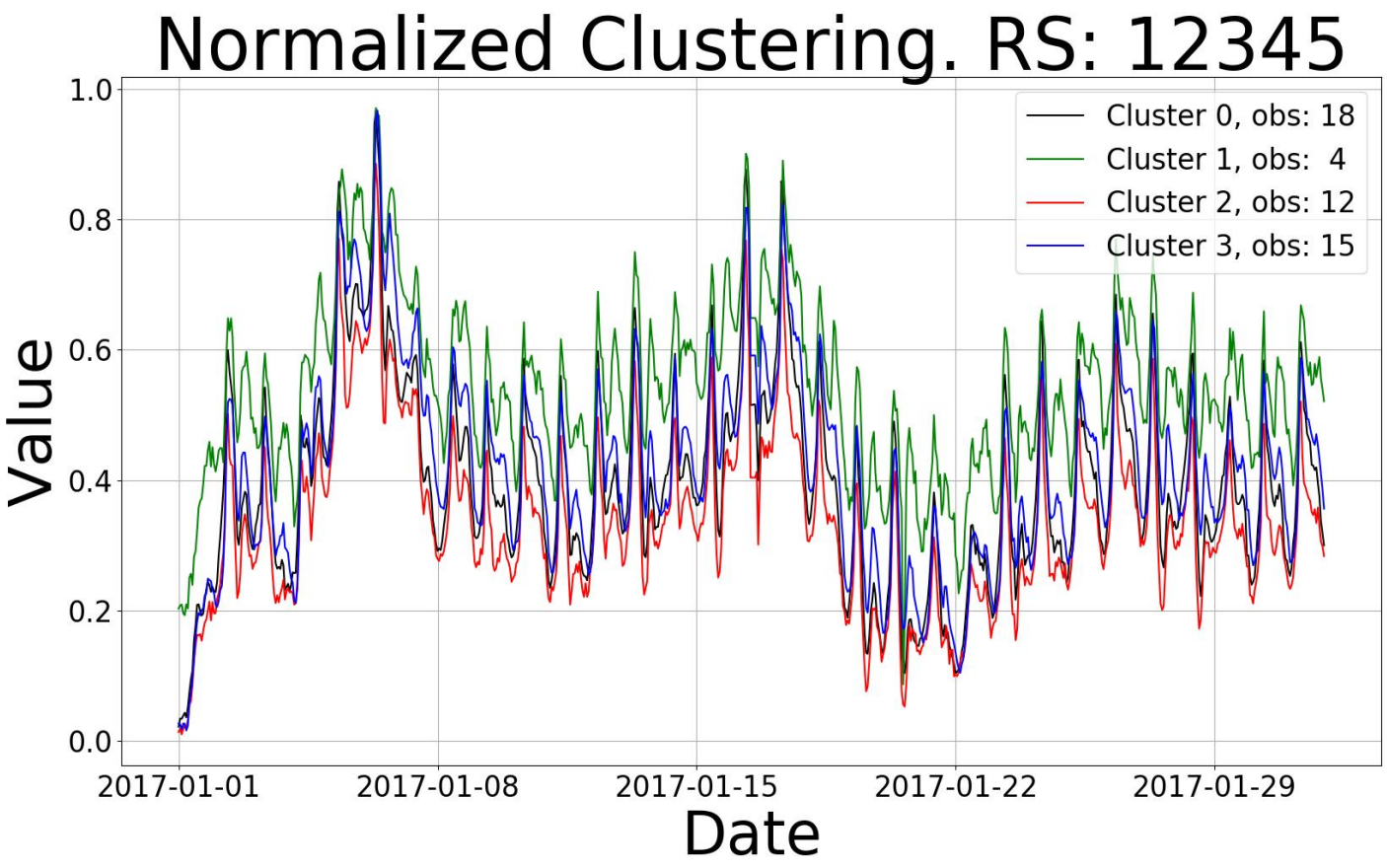
The Clustering of the Original Data Using K-Means

Selecting Optimum Number of Clusters (4) for K-Means



4 clusters selected

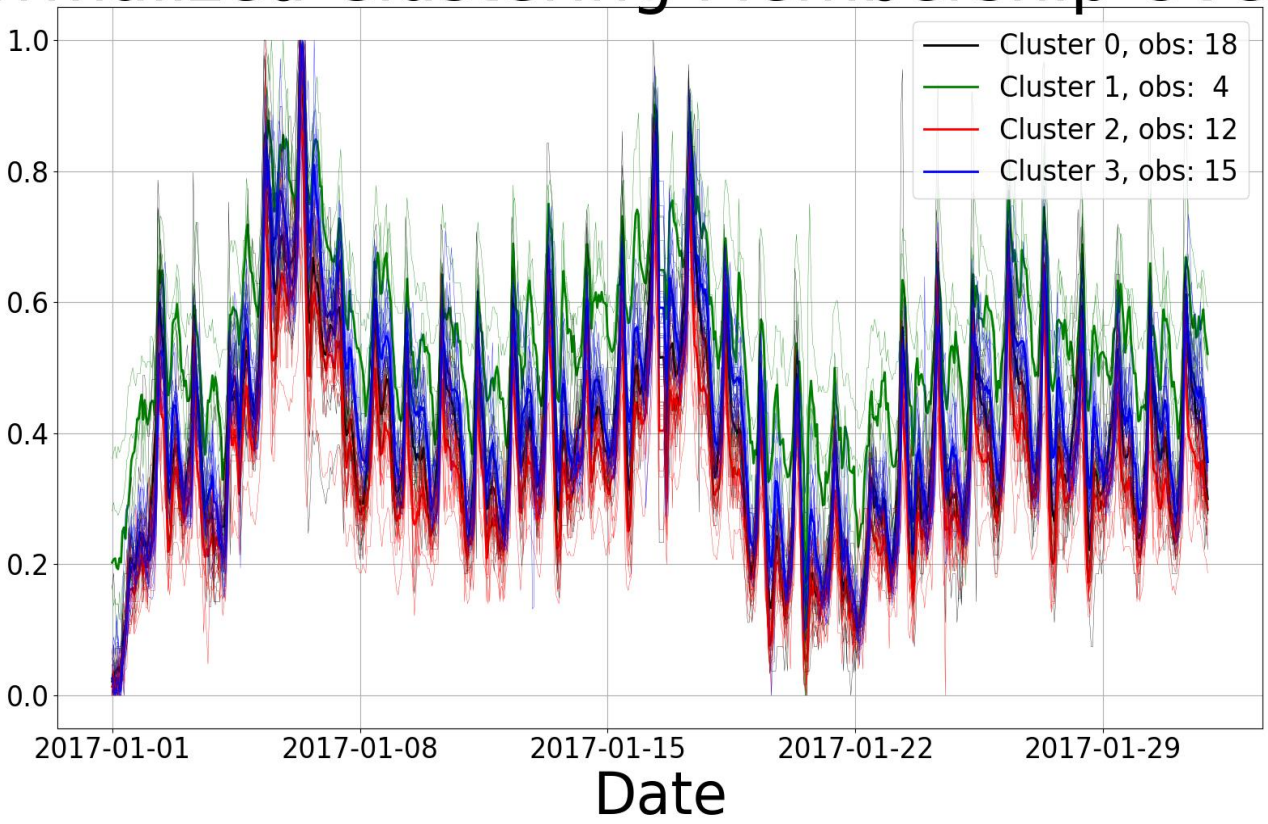
Cluster Means (4) on Normalized Data



4 clusters selected

Cluster Members (49) Superimposed onto Cluster Means

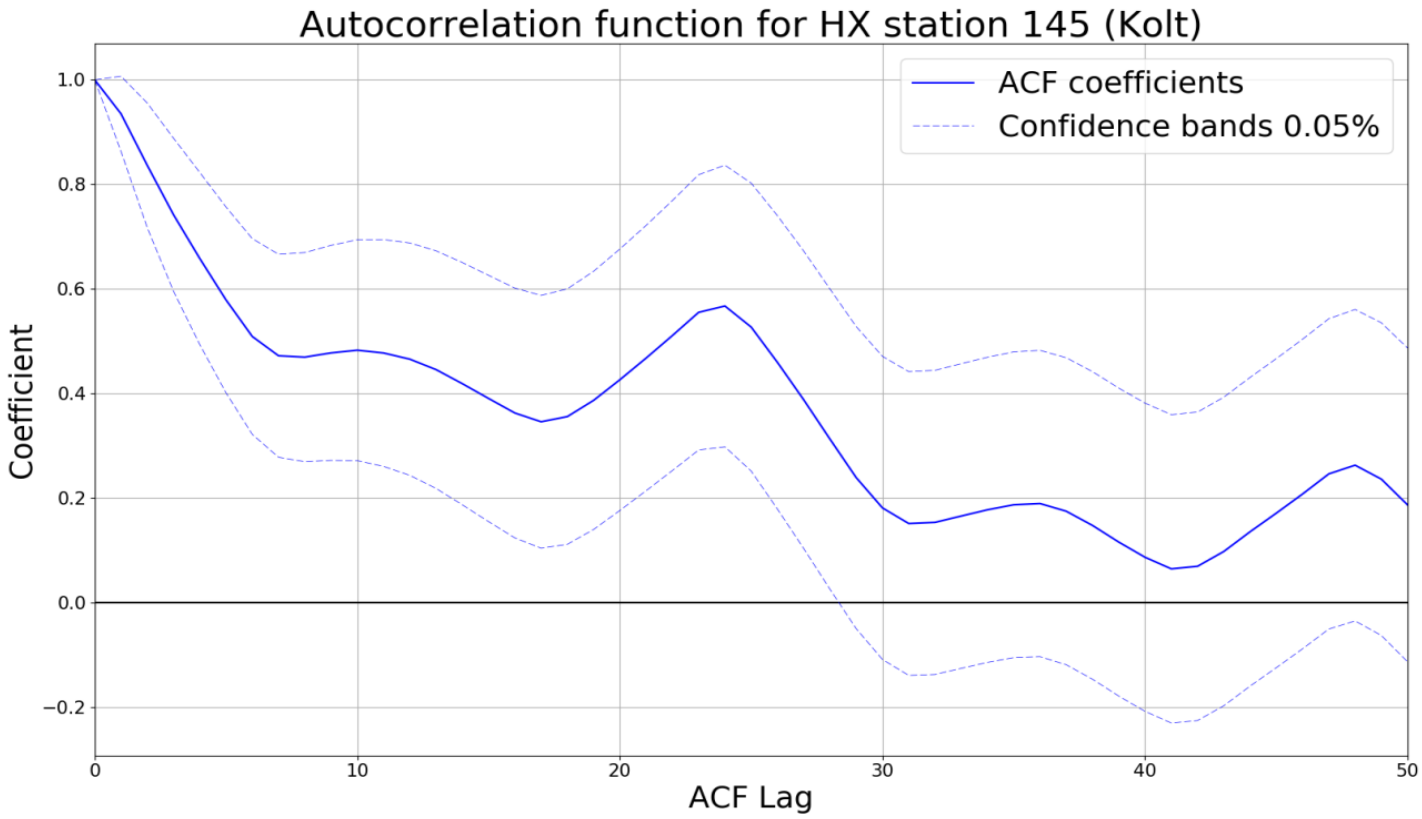
Normalized Clustering Membership Overlay



4 clusters selected

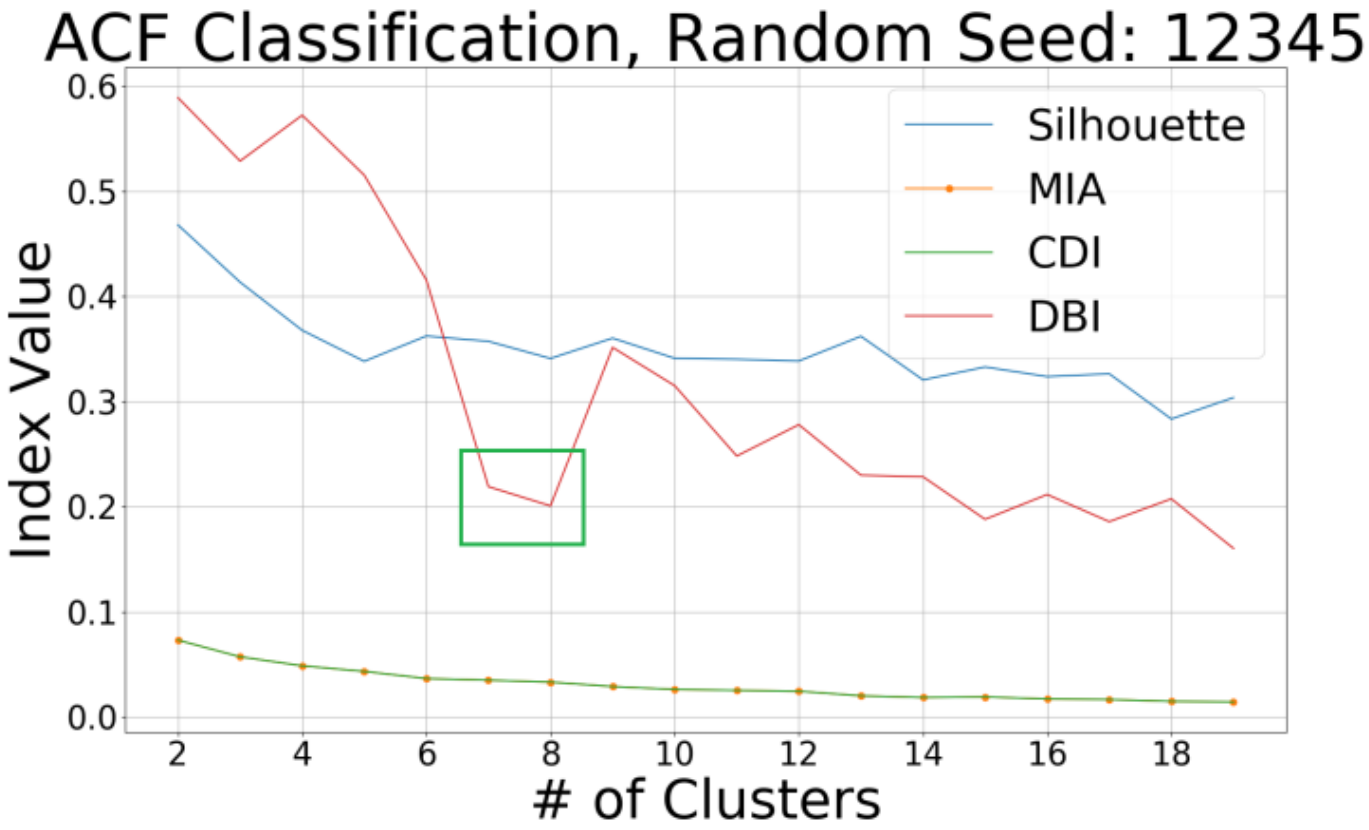
The Preprocessing Revisited: Feature Extraction

Autocorrelation as Feature for Clustering



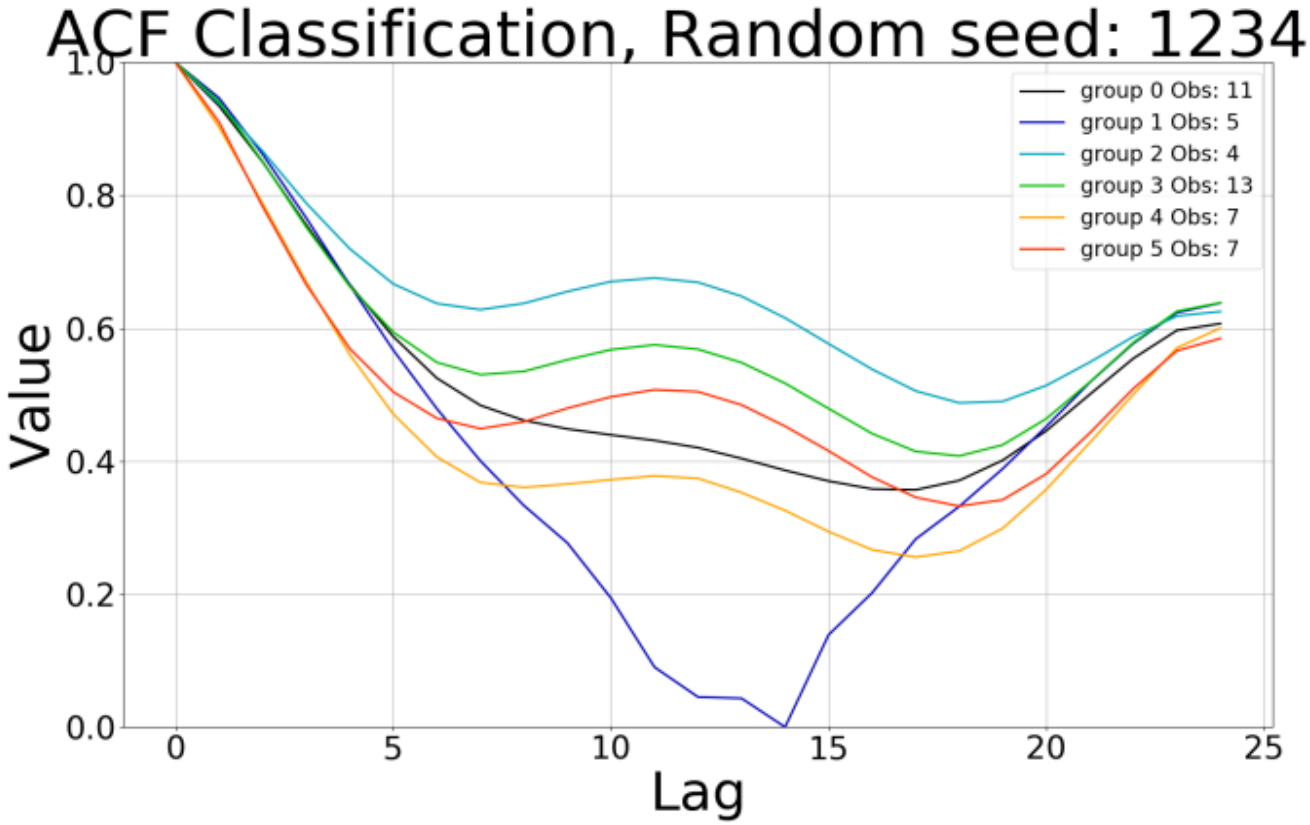
The Clustering Revisited: Features as Input to K-Means

Selecting Optimum Number of Clusters (7) for K-Means on New Feature Data



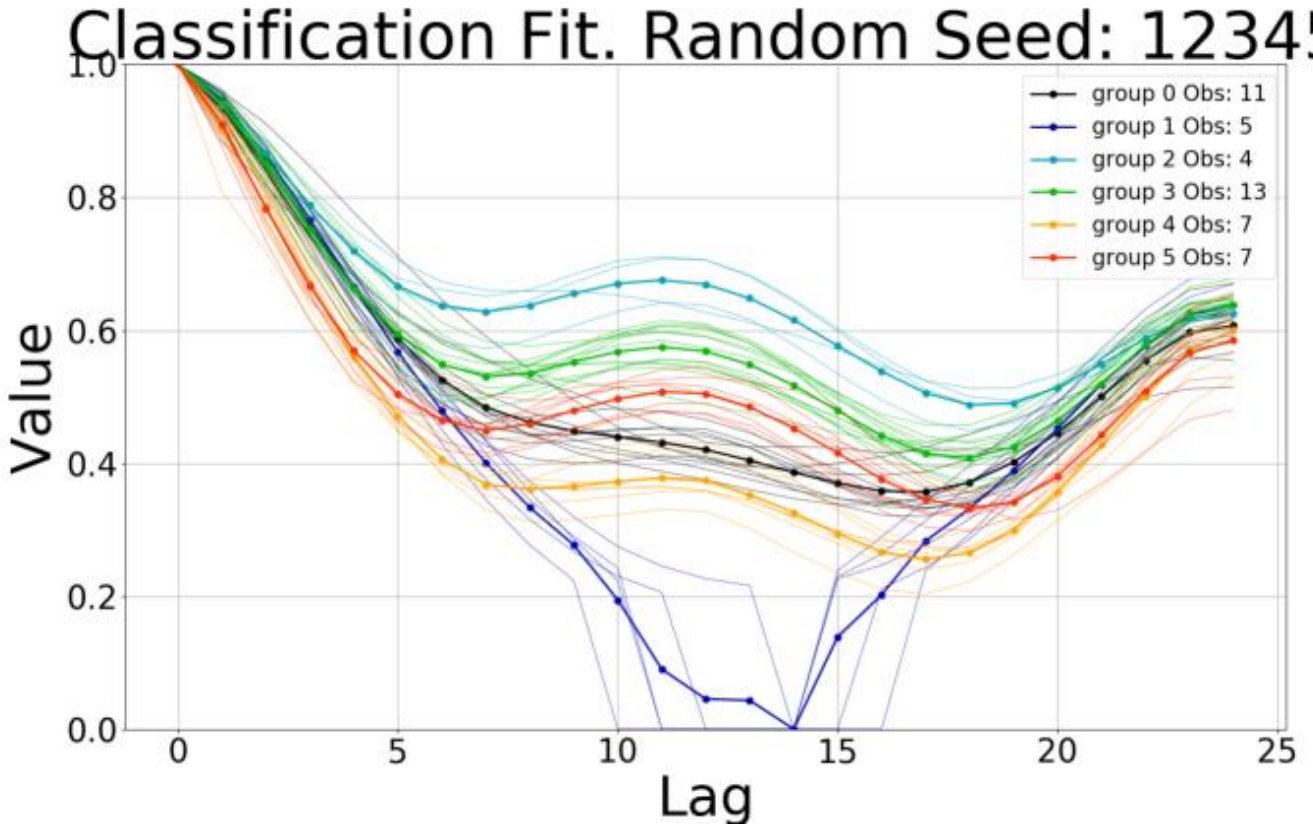
7 Clusters selected

Cluster Means (7) on Feature Input



Only 6 clusters are shown as last cluster only had 1 member.

Cluster Members (49) Superimposed onto Cluster Means

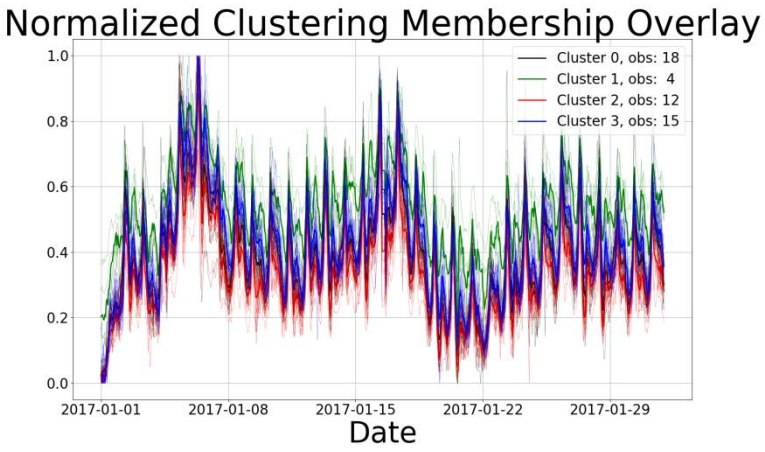


Only 6 clusters are shown as last cluster only had 1 member.

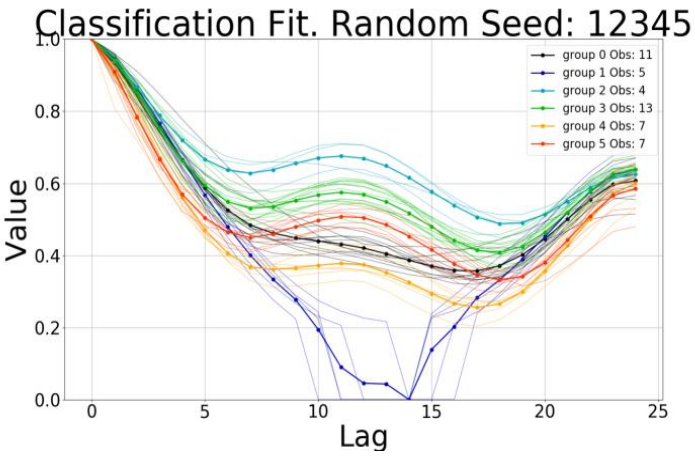
The Findings

Clustering Comparisson

Normalized Data, 4 Clusters



Feature ACF Data, 7 Clusters



For Feature ACF Only 6 clusters are shown as last cluster only had 1 member.

Conclusions

- Classification of Heat Exchangers using Smart Metering data and K-Means can be achieved.
- Preprocessing data for K-Means can improve Clustering performance.
- Classification indicates same underlying model for most Heat Exchangers.
- Outlook
  - Cluster stability Analysis
  - Including jump probabilities
  - Weather / Temperature